

Laparoscopy in Complicated Pediatric Appendicitis

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ABSTRACT

Background: Complicated appendicitis (gangrenous or perforated) has been associated with increased risk for postoperative complications, especially intraabdominal abscess. Caution has been advised when attempting laparoscopic appendectomy for complicated appendicitis in children. The objective of our study was to assess the incidence of intraabdominal abscess formation after laparoscopic appendectomy in pediatric patients presenting with complicated appendicitis.

Methods: This is a retrospective review of 52 pediatric patients presenting with acute appendicitis at a single teaching institution who underwent laparoscopic appendectomy by a single surgeon. All laparoscopic procedures were completed without conversion. Treatment complications and outcomes were recorded for all cases.

Results: Five of the 52 patients (10%) had complicated appendicitis. One of the 5 patients (20%) developed intraabdominal abscess postoperatively and underwent laparoscopic drainage during the same admission. No other complications were noted. None of these patients was readmitted for wound infections or intraabdominal abscesses. The single postoperative abscess occurred early during our initial experience with laparoscopic appendectomy.

Conclusion: Laparoscopic appendectomy seems to be a safe alternative for the treatment of complicated appendicitis in children. Caution is recommended during the initial experience of surgeons with this procedure, because the complication rate seems to be higher during the learning curve. Close postoperative follow-up and a high index of suspicion for development of complications is recommended. As surgeons' experience accumulates, the safety of the procedure seems to increase. A prospective, randomized trial is recommended to establish the role of

laparoscopy in complicated appendicitis in the pediatric population.

Key Words: Laparoscopy, Appendicitis, Children.

INTRODUCTION

Acute appendicitis is the most common surgical emergency in children. Open appendectomy has been the "gold standard." Laparoscopic appendectomy, first performed by Semm in 1983, has become increasingly popular.¹ Children are more likely than adults to present with perforated appendicitis.² Laparoscopic appendectomy is an accepted treatment modality in uncomplicated pediatric appendicitis. The surgical management of complicated pediatric appendicitis (gangrenous or perforated) has been more controversial, and the role of laparoscopy in its treatment has not yet been established.^{3,4} Intraabdominal abscess (IAA) can form after laparoscopic appendectomy (LA), especially in complicated cases and is associated with significant morbidity.^{3,5,6} The aim of our study was to establish the incidence of IAA formation in complicated pediatric appendicitis (CPA) treated with laparoscopy.

METHODS

Pediatric patients presenting with acute appendicitis were identified from our prospectively collected database. Between March 1996 and October 2001, 52 consecutive patients presented with acute appendicitis and were treated at our teaching institution.

LA is performed with the patient under general anesthesia with insufflation of CO₂ pneumoperitoneum. Insufflation pressure is controlled automatically and kept below 12 mm Hg. An instantaneous response capnometer is used to monitor end-respiratory PCO₂. The bladder is emptied with insertion of a Foley catheter. A standard 3-trocar technique is used with two 5-mm trocars and one 12-mm trocar for the introduction of the stapling device (EndoGIA, United States Surgical Corporation, Norwalk, CT). All trocars are placed under vision. The abdomen is gently explored, and the appendix identified. The appendix is freed, and the mesoappendix is divided between applied

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clips or staples. The appendiceal base is divided with the stapling device; the freed appendix is placed in an endoretrieval bag and removed. Peritoneal lavage is completed and hemostasis secured. When present, a special effort is made to debride the fibrin peel from the peritoneum. Patients with CPA have a Jackson-Pratt drain placed in the pelvis and right lower quadrant after completion of the appendectomy; the drain exits through the suprapubic port site. The insufflated gas is released progressively. After removal of the trocars, the fascia and the skin edges are approximated with absorbable sutures. Postoperative analgesia and perioperative intravenous antibiotics are administered in the same fashion as in open appendectomy. Noncomplicated cases received antibiotics only perioperatively, but patients with CPA received antibiotics during their entire hospital stay. An oral diet was resumed usually within 24 hours after admission.

RESULTS

Fifty-two patients diagnosed with acute appendicitis underwent laparoscopic appendectomy. The diagnosis of acute appendicitis in all patients was based on clinical and computed tomography (CT) scan findings. Patients with a positive CT scan underwent laparoscopy, and all of them had appendicitis. Patients with vague symptoms and negative CT imaging were observed and did not undergo laparoscopy. Thirty-five (67%) male and 17 (33%) female patients underwent surgery. Patient age ranged from 4 to 17 years (mean, 12 years). All appendectomies were completed laparoscopically by the senior author (JLZ). All patients were followed for at least 30 days.

Five of the 52 patients (10%) had CPA. Among the patients with CPA were 2 female (40%) and 3 (60%) male patients (**Table 1**). Their mean age was 12 years (range, 4 to 17 years). One of the 5 (20%) patients with CPA developed postoperative intraabdominal abscess and underwent laparoscopic drainage during the same admission. No other complications were noted. None of these patients were readmitted for wound infections or intraabdominal abscesses. The single postoperative abscess occurred early during our initial experience with laparoscopic ap-

pendectomy, and it was the first case of CPA performed laparoscopically. The postoperative course of all patients with uncomplicated appendicitis was uneventful.

The average operative time for laparoscopic appendectomy has been 60 minutes (range, 30 to 120 minutes) and recently 40 minutes. In cases of CPA, the average operative time was 130 minutes (range, 120 to 200 minutes).

The average hospital stay after laparoscopic appendectomy in cases of CPA was 4 days. At the same time, the average length of stay after laparoscopy in noncomplicated acute appendicitis was one day.

The cost of the laparoscopic surgery was difficult to calculate because of the retrospective nature of our study. In recent cases, disposable equipment was used, while in early cases the equipment was nondisposable. The specifics of the equipment used were not always available except for the standard stapling device.

DISCUSSION

Our population consisted of 52 patients presenting with acute appendicitis. All these patients underwent laparoscopic appendectomy plus drainage if the appendix was gangrenous or perforated. All patients with noncomplicated appendicitis were effectively and definitively treated with laparoscopy, and almost all of them were discharged home within 24 hours. No readmissions were necessary. Our findings corroborate previously established knowledge that appendicitis can be safely and effectively treated in children through laparoscopy.⁷⁻⁹

Up to 21% of patients presenting with acute appendicitis can have a perforated appendix.² In our series, 5 (10%) of the 52 patients presenting with acute appendicitis had either gangrenous or perforated appendix. All of these 5 patients with CPA were treated with laparoscopy without conversion to open technique. Only one of these 5 patients (20%) with CPA developed an IAA. The abscess was drained laparoscopically during the same admission. Although the patient underwent an extra laparoscopic procedure, it was well tolerated, and he was discharged home without other complications. This single complication occurred during the initial learning curve of laparoscopic appendectomy, was the first case of laparoscopic appendectomy performed for CPA at our institution, and was associated with a long operative time. Since then, as experience has accumulated, no more complications have occurred after laparoscopic appendectomy for CPA.

All study patients with complicated appendicitis had

	Simple	Complicated
Male	32 (62%)	3 (6%)
Female	15 (29%)	2 (3%)

drains placed in the abdomen for drainage. A high degree of suspicion and liberal use of imaging helps in the diagnosis and early treatment of postoperative IAA. In a recent study,¹⁰ it was suggested that the placement of drains in the right lower quadrant might be beneficial in patients with perforated appendicitis and localized abscess cavities. In that study, 4 (80%) of 5 patients with CPA had an uneventful laparoscopic appendectomy. All these patients had drains placed in the right lower quadrant.

It has been suggested in the past that laparoscopic appendectomy for CPA in children is not a safe procedure and should be avoided.³ Our recent findings suggest that laparoscopy can be a reasonable therapeutic alternative to open appendicitis in these complicated cases. The incidence of postoperative IAA formation after laparoscopy in children with CPA varies anywhere between 5.8% and 41%.^{3,5,6,11} Some of these abscesses are treated with antibiotics, but most of them require drainage. In another recent study,¹² comparing laparoscopy to open appendectomy for CPA, no IAA occurred after LA. In contrast, 3.1% of patients developed IAA after open appendectomy.

It has been suggested that visualization of the abdominal cavity seems to be improved with laparoscopy. The pelvis and the abdominal cavity can be thoroughly irrigated, debrided, and drained. Coexisting pathology can be identified and addressed. The surgery is less traumatic, and most patients return to their regular activities sooner.^{13,14}

On the other hand, in cases of perforated appendicitis, anatomy can be obscure, and the operative time can be significantly prolonged. Laparoscopy in complicated cases of acute appendicitis can be a challenging and technically demanding procedure that requires more than basic laparoscopic skills. There is limited tactile sensation, manipulation of inflamed tissues is difficult, and inadvertent injury to adjacent organs is possible. One should attempt laparoscopy in these complicated cases only after performance of many routine laparoscopic appendectomies. Preoperative diagnosis of complicated appendicitis might be elusive. Access to preoperative CT scanning might help identify the complicated cases of acute appendicitis. It cannot be overemphasized that one should be prepared to convert early to an open appendectomy should a difficult case of CPA be encountered. That is especially true when the surgeon is on the initial part of the learning curve.

We recognize the limitations of our study. Our analysis is a single-surgeon, single-institution study. Our data were retrospectively collected, and the numbers are too small to draw safe conclusions. Our findings and those of others

suggest that laparoscopy might be a safe alternative even for CPA, but properly randomized, prospective studies will answer this question.^{5,8}

Complicated appendicitis in children can be effectively treated with laparoscopy by experienced laparoscopic pediatric surgeons. Based on our experience, we currently recommend laparoscopy in children with complicated appendicitis. Placement of drains might be beneficial. Complicated appendicitis should not be considered a contraindication for laparoscopy, but more solid evidence is necessary before it becomes the standard treatment.

CONCLUSION

Laparoscopic appendectomy is a safe alternative for the treatment of complicated appendicitis in children. Caution is recommended during the initial learning curve. Close postoperative follow-up and a high index of suspicion for development of complications is essential. Prospective randomized trials will be necessary to establish the role of laparoscopy in complicated appendicitis in the pediatric population.

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